July 28, 1931. A. A. G. LAND 1,816,381

WIRE FENCE OR GRILLE FABRIC

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Fig. 1.

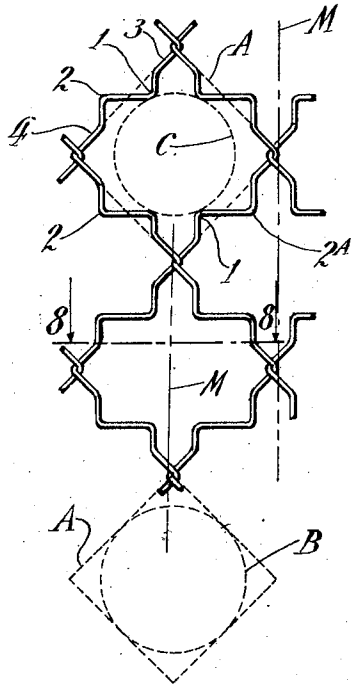


Fig. 2.

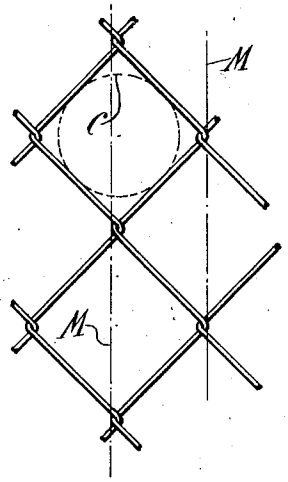


Fig. 3.

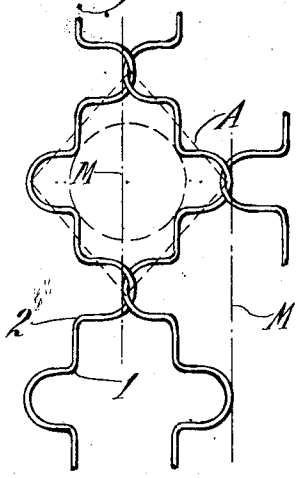
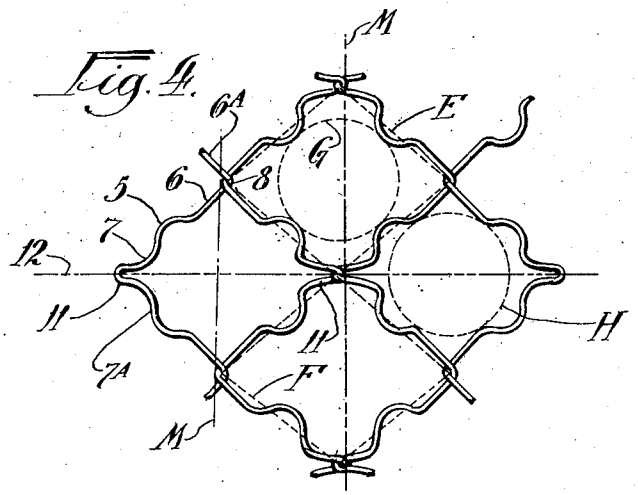


Fig. 4.



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Fig. 5.

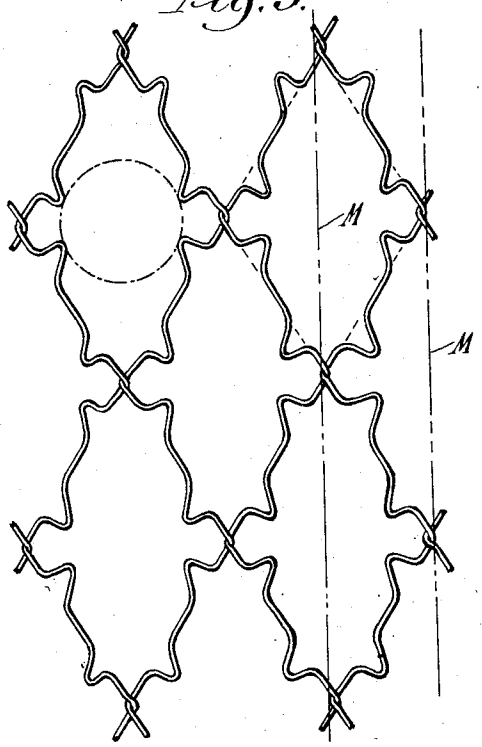


Fig. 6.

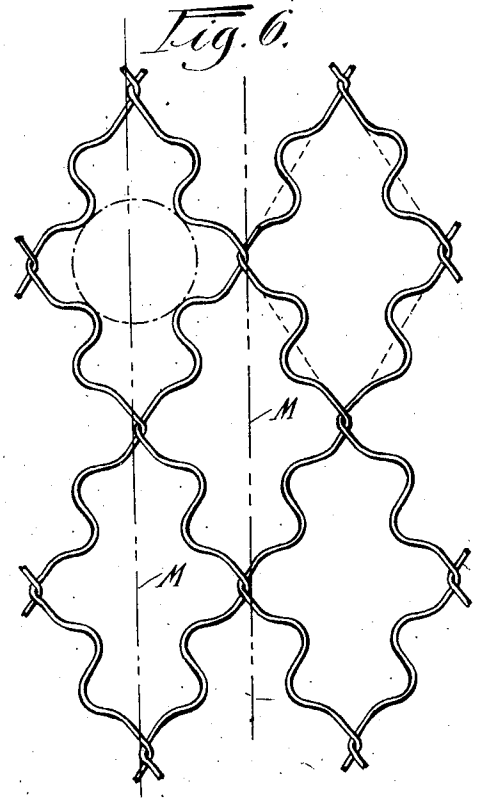


Fig. 7.

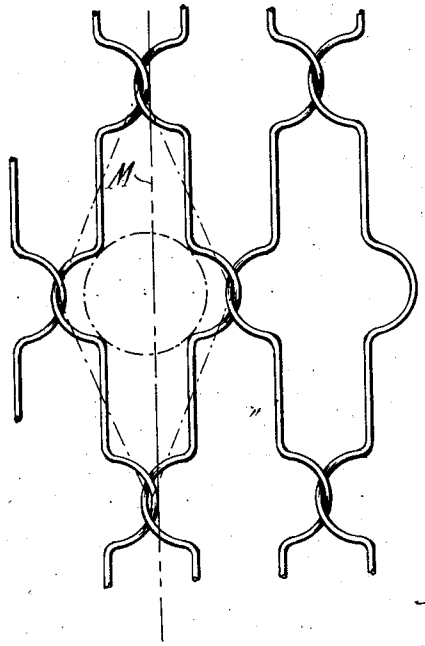


Fig. 8.



Fig. 9.



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Fig. 10.

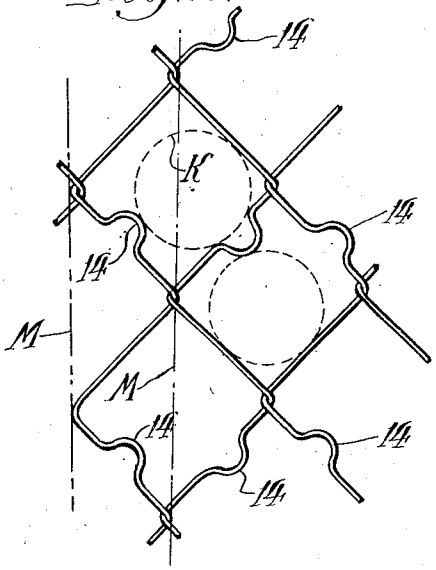


Fig. 11.

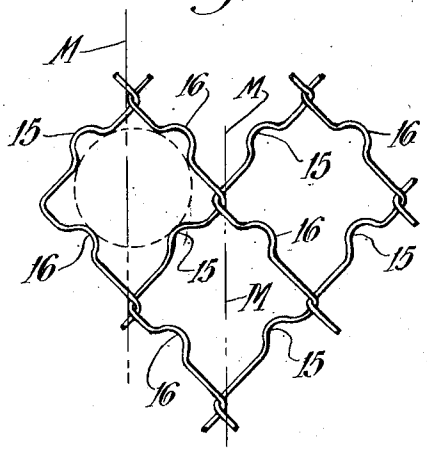


Fig. 12.

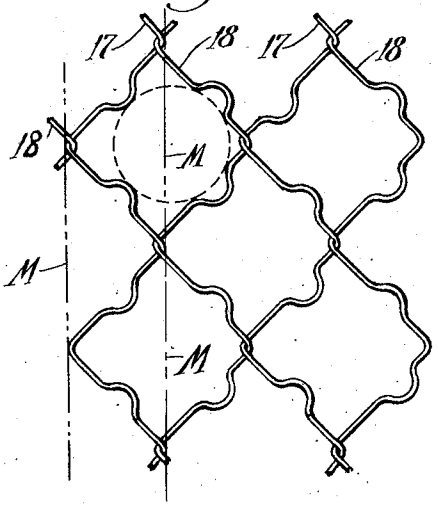
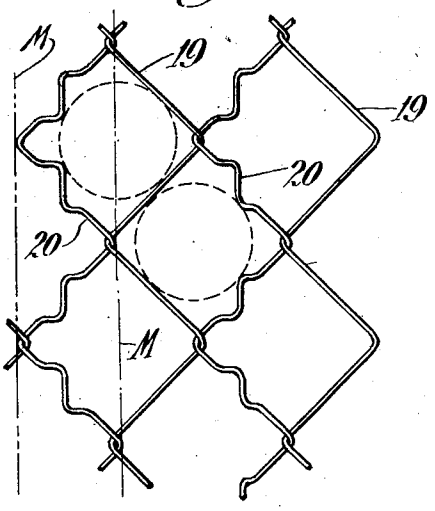


Fig. 13.



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UNITED STATES PATENT OFFICE

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WIRE FENCE OR GRILLE FABRIC

Application filed November 7, 1928. Serial No. 317,841.

My invention relates to interwoven wire fabrics of the class commonly used for wire fences, grilles, base-ball back-stops and the like, namely so called chain link wire fabrics made by consecutively twisting (or "weaving") into each other wire spirals which are flattened. Such chain link wire fabrics have long been made of strands formed by winding a wire spirally around a flat mandrel, so that the major portion of each strand consists of consecutively diverging wire portions which cooperate in the adjacent strands of the interwoven fabric to form square or diamond-shaped meshes. In such fabrics, the size of the substantially square or diamond-shaped mesh suited for any given purpose usually depends on the size of the objects which the wire fence or the like is to exclude. For example, for a fence around a tennis court, the mesh must be sufficiently small so that a standard sized tennis ball is larger in diameter than the diameter of the circle which can be inscribed within the mesh of the fence. In practice, this determining factor makes it necessary to use a much smaller mesh for the fencing than is required for resisting the strains which the fence has to stand; consequently, such wire fencing as now in common use not only requires a much larger number of constituent strands in proportion to its surface area than would be needed for its strain-resisting strength, but also involves a corresponding increase in the cost of interweaving the strands and in the transportation expenses.

My present invention aims to provide chain link wire fabrics for fences or the like which will accomplish the same object-excluding purposes with fewer wire strands employed for the same surface area; and which will reduce both the total weight of wire required for a given fence or the like, the cost of interweaving the needed strands, and the transportation costs.

Furthermore, my invention aims to provide such reductions in cost by employing preformed wires which will also give an ornamental appearance to the resulting fence, grille or the like; which will readily permit wide variations of the resulting ornamental effect so that the latter can harmonize with the architecture or design of adjacent buildings and with the taste of the user; and which will increase the resistance of the resulting fence or the like to transverse strains.

Still further objects of my invention will appear from the following specification and from the accompanying drawings, in which

Fig. 1 is an elevation of a fragment of a wire fabric embodying my invention and based on a square mesh arrangement, with a dotted line showing the periphery of the largest ball which would pass through this wire fabric, and with a lower dotted portion showing the larger sized ball which would pass through an ordinary chain wire fence of the same mesh-corner spacing.

Fig. 2 is a contrasting fragmentary elevation of a wire fabric of the usual interwoven type, showing the smaller size of mesh and the increased number of wire strands which would be required in an ordinary chain link wire fence to exclude the size of ball indicated in the upper portion of Fig. 1.

Fig. 3 is a fragmentary elevation of a wire fabric, showing another shaping of the preformed bends in the constituent strands, also having the interlocking portions of adjacent strands arranged at the corners of imaginary squares.

Figs. 4, 5, 6 and 7 are fragmentary elevations of wire fabrics showing other arrangements of the auxiliary kinks or bends in the constituent wire strands, and each arranged so that the interlinking points of the strands form the corners of diamond-shaped figures.

Fig. 8 is an enlarged horizontal section taken along the line 8—8 of Fig. 1 to show the general planes in which each two adjacent mesh legs of a strand are disposed.

Fig. 9 is a section similar to the main portion of Fig. 8, showing another formation of my interwoven strands, namely one in which the mesh legs of all of the strands have their axes in a common plane.

Fig. 10 shows a fragment of a chain link type of wire fabric in which every alternate

leg of each strand has a single bend bowed toward the longitudinal axis of the strand.

Fig. 11 shows a fragment of a chain link type of wire fabric in which every alternate leg of each strand has a single bend bowed toward the longitudinal axis of the strand, and in which each intervening leg of each strand has a single bend bowed away from the longitudinal axis of the strand.

Fig. 12 shows a fragmentary elevation of a fabric in which the alternate strands are duplicates of each other as to their formations, and in which every leg of each strand has a bend bowed in the same direction laterally of the fabric.

Fig. 13 shows a fragment of a fabric composed of ordinary chain link strands alternating with strands embodying my invention.

Generally speaking, I accomplish the objects of my invention by utilizing three underlying principles:

One is the fact that in any fabric or structure having meshes, the providing of the legs (or sides) of each mesh with bends extending into a mesh will reduce the object-excluding size of the mesh. A second is the fact that suitably formed bends in such mesh legs stiffen the latter, so that a given rigidity and strength can be secured with a smaller diameter of wire for the strands than is needed when the mesh legs are straight as in the now customary constructions.

The third is the fact that the auxiliary bends or kinks (which I employ for the purpose of reducing the effective object-excluding size of the mesh and for permitting the use of lighter wire strands) can readily be so formed and arranged as to make the resulting fence or the like decidedly ornamental in appearance.

Illustrative of my novel fabric, Figs. 1 and 3 show fragmentary elevations of two wire fabrics each formed of consecutively interwoven wire strands extending in a generally upright direction. Each such wire strand is preformed into a flattened spiral in which the consecutive half-turns diverge in a general direction at right angles to each other, so that the bights in the interwoven wire strands are disposed at the corners of imaginary squares having one diagonal vertical.

If each half-turn of each such flattened spiral were straight when viewed in elevation, the resulting square mesh would be substantially as indicated by the dotted lines A at the lower end of Fig. 1, so that a ball of the periphery shown at B would still pass through the mesh.

To make a fabric based on the same spacing of the interlocking bights exclude a considerably smaller ball, I provide each half turn of the preformed (flattened spiral) wire strand with auxiliary bends or kinks 1 and 2 which extend in the same general vertical plane with the half turn portions 3 and 4 adjacent to the bights connected by that half turn, but which bends 1 and 2 project beyond the general direction of the portions 3 and 4 in respectively opposite directions. With counterpart auxiliary bends or kinks thus provided in every half turn of the preformed wire strands, and with the laterally consecutive strands laterally reversed (after the usual manner) when interwoven, the bends 1 are re-entrant for one vertically alined row of the resulting meshes, as shown in the left-hand portion of Fig. 1.

However, these bands 1 project inward of the imaginary square A which connects the corners of the adjacent vertical row of meshes. On the other hand, the bends 2 which project outwardly of the said imaginary square in the left-hand row of Fig. 1 extend inwardly of the corresponding imaginary squares in the adjacent vertical row of meshes, as shown for example at 2^A.

Consequently, the maximum periphery of a ball which would pass through the meshes of such a fabric would be that shown in dotted lines at C, or a ball much smaller in diameter than the ball B in the same figure. To produce an exclusion of equal effective size of that of the fabric of Fig. 1 with the ordinary chain link type of fabric in which the half turns of the spiral strand are straight, the length of the half turns would have to be reduced as shown in Fig. 2, thereby correspondingly reducing the diagonals of the imaginary mesh squares and requiring a much greater number of the interwoven wire strands per lineal foot of the fabric.

Comparing Figs. 1 and 2, it will be noted that the fabric of Fig. 1 requires a somewhat greater length of wire for each constituent strand than that of Fig. 2, but the number of such strands required for a given length and height of fabric is so much less for my Fig. 1 type than for the ordinary type of Fig. 2 that the total wire required is still less for my novel type than for the older type of Fig. 2.

Moreover, since the cost of the intertwisting (or socalled interweaving) of the consecutive strands depends on the number of strands employed, this important item of cost is considerably less for my novel type of Fig. 1 than for the corresponding older type of Fig. 2. Since the auxiliary bends in the wire strands of Fig. 1 all are disposed approximately in the general plane of the fabric, these bends also increase the resistance of the fabric to strains in directions transverse of that plane—as for example, to the impact of a ball driven against the fabric at right angles to the said plane. Con-

sequently, the same effective resistance to such transverse strains can be secured with my fabric of Fig. 1 when the strands are made of somewhat lighter wire than required for the older type of Fig. 2, so that I can further reduce the total required weight (and hence the cost) of the needed wire, thereby also reducing the cost of transportation for the fabric.

Incidentally, the preforming of the auxiliary bends or kinks in the wire strands also imparts a decidedly ornamental effect to the fabric, and the resulting attractive appearance can readily be varied, as shown for example in Fig. 3. This preliminary kinking or preforming of the auxiliary bends is quickly and cheaply effected by passing the initially straight wire between suitable grooved counterpart forming tools (with which wire workers are quite familiar) either before or after the resulting kinked or crinkled wire is bent to its general shape of a flattened spiral, so that the cost of this added operation is quite small in proportion to the saving effected in the cost of the needed wire and of the interweaving.

To make the resulting reduction in the object-excluding size of the mesh highly effective in proportion to the length of wire in each strand leg (or half-turn of the spiral), I may form each such strand leg to afford two bent portions spaced longitudinally of that leg. These two bent portions in each strand leg (or mesh side) respectively extend inward and outward of one of the two meshes of which that leg forms a side, and these two bent portions may be directly connected to each other so that they jointly afford a substantially S-shaped bent leg portion which extends across a line connecting the bights at the ends of that leg.

However, I do not wish to be limited to the providing of two such oppositely bowed bent portions on a single leg, nor to the providing of such bends on every leg of the strand, nor to the use of counterpart strands in my fabric. Neither do I wish to be limited to the use of strands in which the consecutive legs diverge substantially at right angles from each other, so that the interlocked bights form corners of imaginary squares. These intermeshing bights can equally well be disposed at the corners of imaginary diamond-shaped figures, and the preforming of the wires may even be such that meshes in adjacent vertical rows appear to be decidedly different in size, although designed to exclude objects of the same minimum size.

For example, Fig. 4 shows an embodiment of my invention in which each half-turn of every one of the counterpart strands includes a single kink or bent portion 5 connecting two wire portions 6 and 7 which portions 6 and 7 are in longitudinal alinement with each other. The wire portion 6 is connected by a sharp bend 8 (which interlocks that wire strand with the next one) to a counterpart wire portion 6^A of the same strand, while the other portion 7 is connected to its counterpart 7^A by a relatively long and narrow loop 11 having its axis on a line 12 connecting two opposite corners of the determining imaginary mesh figure.

This figure here is a diamond, and these diamonds are counterparts for all of the meshes, as shown in dotted lines at E and F. In this embodiment, the loops 11 make the wire meshes in one vertical row appear to be considerably smaller than those in the adjacent vertical row, although the parts of each half-turn of every strand are designed for excluding balls in excess of the same minimum diameter, namely that of the balls G and H. Consequently, Fig. 4 shows how my invention enables me to provide wire fabrics of uniformly distributed object-excluding quality, while affording the enhanced beauty due to a variation in the appearance of different meshes.

On the other hand, the counterpart wire strands while designed for meshes interconnected at the corners of diamond-shaped imaginary figures may be shaped to present uniform shapes for all of the meshes, and by varying the shape and location of the bends in the legs, the resulting mesh shapes can be varied indefinitely, as shown for example in Figs. 5, 6 and 7. In each case, the change in design merely requires the use of differently shaped forming tools for the pre-kinking, as the same machine can readily be employed for forming the selectively kinked wire into a flattened spiral, so that the additional equipment for manufacturing endless varieties of my wire fabric consists only of corresponding rolls for preforming the auxiliary bends or kinks in the wire.

It will also be evident from the drawings that with each of the previously described six embodiments (namely, those of Fig. 1 and of Figs. 3 to 7 inclusive), every half-turn of each spirally flattened strand has a portion projecting inwardly beyond a straight line connecting the middle points of the bights between which that half-turn extends. This figure is a diamond in every one of the illustrated fabric portions, since the square in Fig. 1 is merely a diamond with right angles between its adjacent sides, hence it is to be understood that the term diamond-shaped has been used by me in the broad sense in which it also includes a square shape.

In practice, the precise extent of the flattening of the spiral, into which each prekinked strand is formed, is immaterial, as this may be varied to suit the convenience of

the manufacturer. For example, the major portions of two successive half-turns of the spiral may respectively have their axes in two planes parallel to, but at opposite sides of, the medial plane of the fabric, namely the plane 13 which extends through the middle points of all of the bights, as shown in Fig. 8. Or, the major portions of all half-turns (or mesh legs) may all have their axes in the said medial plane 13 of the fabric, if each strand is formed to include bight loops 14 as shown in Fig. 9. In either case, every strand can readily be interwoven with the next preceding one by inserting it endwise of the latter with a spiral advancing movement.

Furthermore, I do not wish to be limited to the providing of the use of bends which make each leg of the strand a counterpart of other legs, nor even to the providing of bends on every leg of the strand, as my invention may be employed in a wide variety of ways without departing from its spirit.

For example, Fig. 10 shows a portion of a chain-link wire fabric in which the alternate half-turns of each spiral strand (or alternate legs of each strand) present substantially straight mesh sides, while each intervening leg of the strand has a single bent portion formed in it, these bent portions being similarly directed in the said intervening legs of a strand. Each of the resulting meshes then has only a single re-entrant wire portion, but even this considerably reduces the size of an object which would still pass through the mesh, as shown for a ball by the dotted circle K.

In the fabric of Fig. 11, each composite strand has a single bent portion in every leg thereof, but these bent portions 15 and 16 are oppositely directed in consecutive legs, so as to extend respectively into two adjacent meshes.

In the fabric of Fig. 12, every leg of each composite strand has a single bent portion and these bent portions all extend in the same direction transversely of the length of the strand. In this case, the alternate strands 17 are of counterparts of each other, but the intervening strands 18 have their bent portions directed oppositely from those in the said alternate strands.

In each of the heretofore described embodiments, it will be noted that each bent portion in a given strand is bowed (and projects from the general direction in which the strand leg extends) toward an imaginary edge line M extending along the bights at one side edge of the strand. Moreover, since the departure of each bent portion from the general plane of the wire fabric is quite small in proportion to the length of the strand legs or mesh sides, these bent portions may extend approximately in the general plane of the wire fabric.

However, while I have heretofore described fabrics composed entirely of wire strands preformed according to my invention, the general purposes of my invention can also be accomplished by using such preformed wires only for half of the strands, and alternating these with ordinary chain-link wire strands in which the half-turns or legs have no mesh-size-reducing bent portions. For example, Fig. 13 shows both the effective reduction in the size of mesh and the ornamental appearance produced by using ordinary chain-link wire strands 19 with interposed strands 20 which were preformed according to my invention.

So also, while I have heretofore described my invention as employed in a wire fabric designed for halting and excluding balls I do not wish to be limited to the purposes for which my interwoven fabric may be employed. For example, the same auxiliary bends or kinks, which reduce the effective size of my meshes in proportion to their interlinked dimensions, also reduce the foothold which a prospective trespasser can get on my fabric, so that my wire fabric is quite generally suitable for use as a more economical substitute for older types of wire fences, grilles, or the like. It is likewise adapted for window-guards, door-guards, and wire screens of various kinds.

In the claims, it is to be understood that the term "mesh side" is used to designate the entire portion of a single strand which is interposed between any two consecutive bights of the strand; and that the term "bight" is used to designate the bends of adjacent strands which are interlocked in the assembled fabric.

I claim as my invention:

1. A chain-link wire fabric comprising preformed zigzag strands consecutively intertwisted so that each two consecutive strands border a row of four-sided meshes; one of every two consecutive strands being continuously spiraled in the same direction, and being formed so that one side of each mesh which is partly bordered by the said strand is bent to present two oppositely directed bends connected by a strand portion crossing a straight line connecting the ends of that mesh side, one of the said bends projecting into a mesh at one side of the said strand for such a distance as materially to reduce the maximum size of objects which will be excluded by the last-named mesh.

2. A chain-link wire fabric comprising flattened spiral strands each continuously spiraled in the same direction, each two consecutive strands being interlocked to form a row of four-sided meshes, the strands being formed to provide at least one side of each mesh with a bend kinked for a considerable distance toward the center of that mesh, thereby materially reducing the minimum

distance between the center of that mesh and the said mesh side in proportion to the distance between the same mesh center and an imaginary straight mesh side connecting the ends of that mesh side.

3. A chain-link wire fabric comprising consecutively intertwisted zigzag strands forming rows of four-sided meshes, each strand being continuously spiraled in the same direction, every two adjacent rows of meshes having two sides of each mesh formed by a single strand, the said single strand having in single mesh-side-forming parts thereof two bends bowed respectively into meshes of the two adjacent rows, the extent of the bowing being such that the bends materially reduce the maximum size of objects which can pass through the meshes into which the said bends are bowed.

4. A chain-link type of wire fabric comprising zigzagged strands each continuously spiraled in the same direction, each two consecutive strands being spirally intertwined to border a row of four-sided meshes in which meshes two consecutive mesh sides are formed by one strand, one of two consecutive strands being provided with bends bowed for a considerable distance toward the next strand to reduce the effective openings of meshes formed by the said two consecutive strands.

5. As a constituent for a fabric composed of consecutively intertwined strands, a zigzag strand continuously spiraled in one direction, and presenting consecutively diverging legs when viewed in front elevation, one of every two consecutive legs having a portion thereof formed to afford a bend bowed for a considerable distance toward the other leg.

6. As a constituent for a fabric composed of consecutively intertwined strands, a zigzag strand continuously spiraled in one direction, and presenting consecutively diverging legs when viewed in front elevation, at least a portion of the strand having in one of every two consecutive legs thereof two portions formed to afford two bends lying approximately in the general plane of the strand and bowed for considerable distances respectively toward and away from the other leg.

7. As a constituent for a fabric composed of consecutively intertwined strands, a zigzag strand continuously spiraled in one direction, and presenting consecutively diverging legs when viewed in front elevation, one of every two consecutive legs in at least a portion of the strand having a portion thereof formed to afford a bend bowed for a considerable distance toward the other leg, each two consecutive legs being disposed for substantially their entire length respectively forward and rearward of the general plane of the strand.

8. As a constituent for a fabric composed of consecutively intertwined strands, a zigzag strand continuously spiraled in one direction, and presenting consecutively diverging legs when viewed in front elevation, including a strand portion in which one of every two consecutive legs has a portion thereof formed to afford a bend bowed for a considerable distance toward the other leg, the said bends in different parts of the said strand portion being similarly disposed with respect to the ends of the legs in which they are formed.

Signed at Chicago, Illinois, November 5th, 1928.

ARTHUR A. G. LAND.